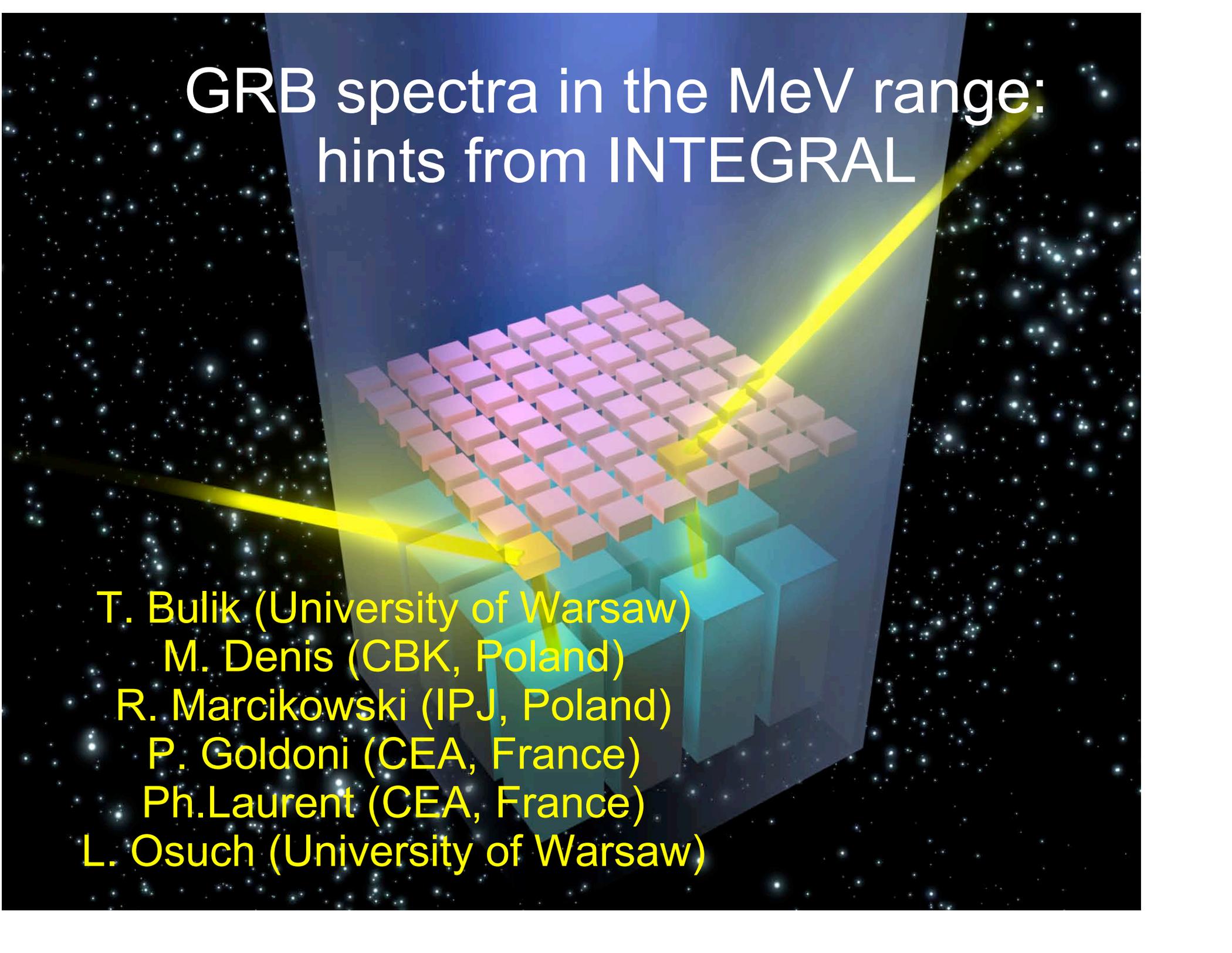
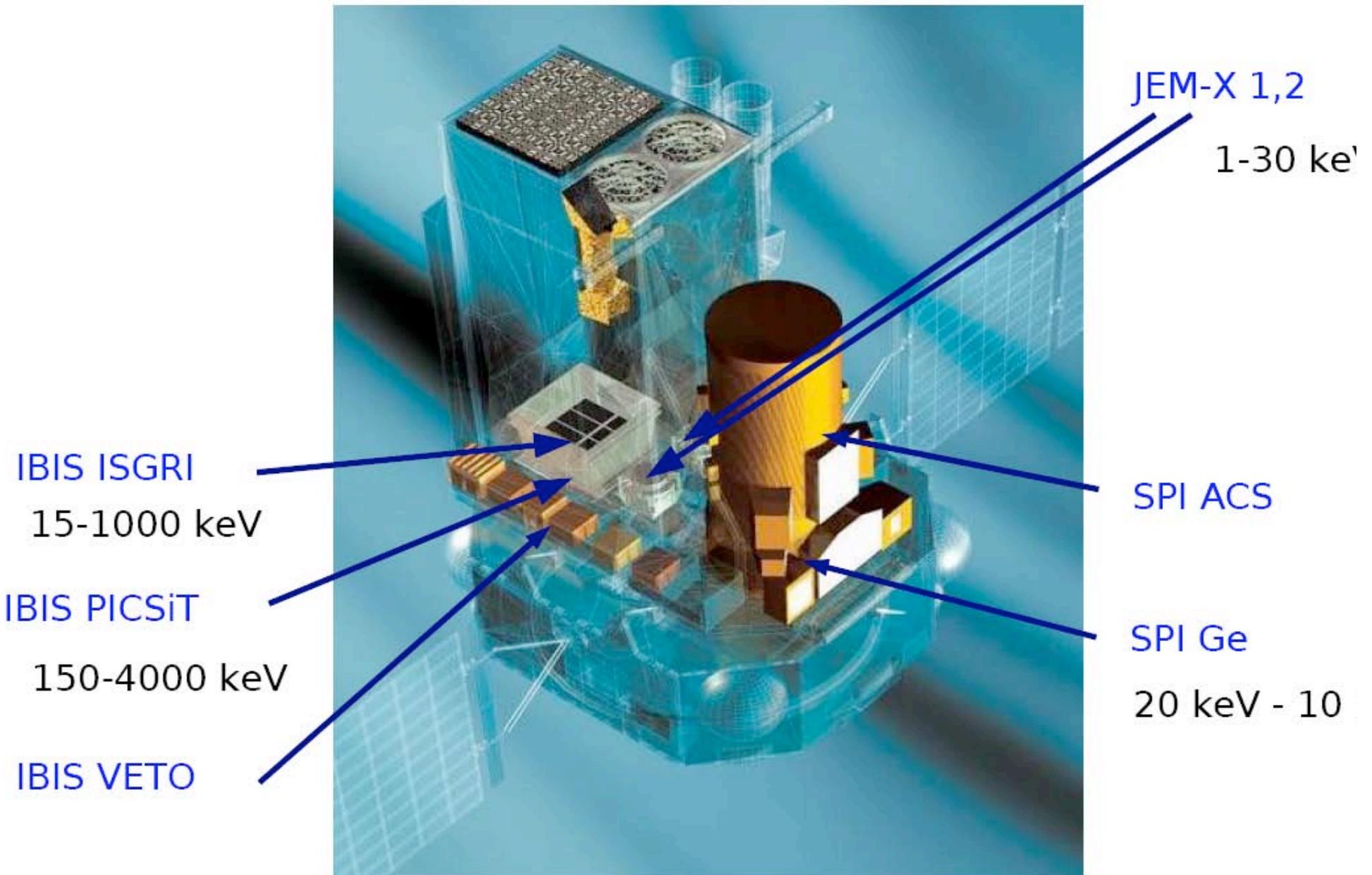


GRB spectra in the MeV range: hints from INTEGRAL



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M. Denis (CBK, Poland)
R. Marcikowski (IPJ, Poland)
P. Goldoni (CEA, France)
Ph. Laurent (CEA, France)
L. Osuch (University of Warsaw)

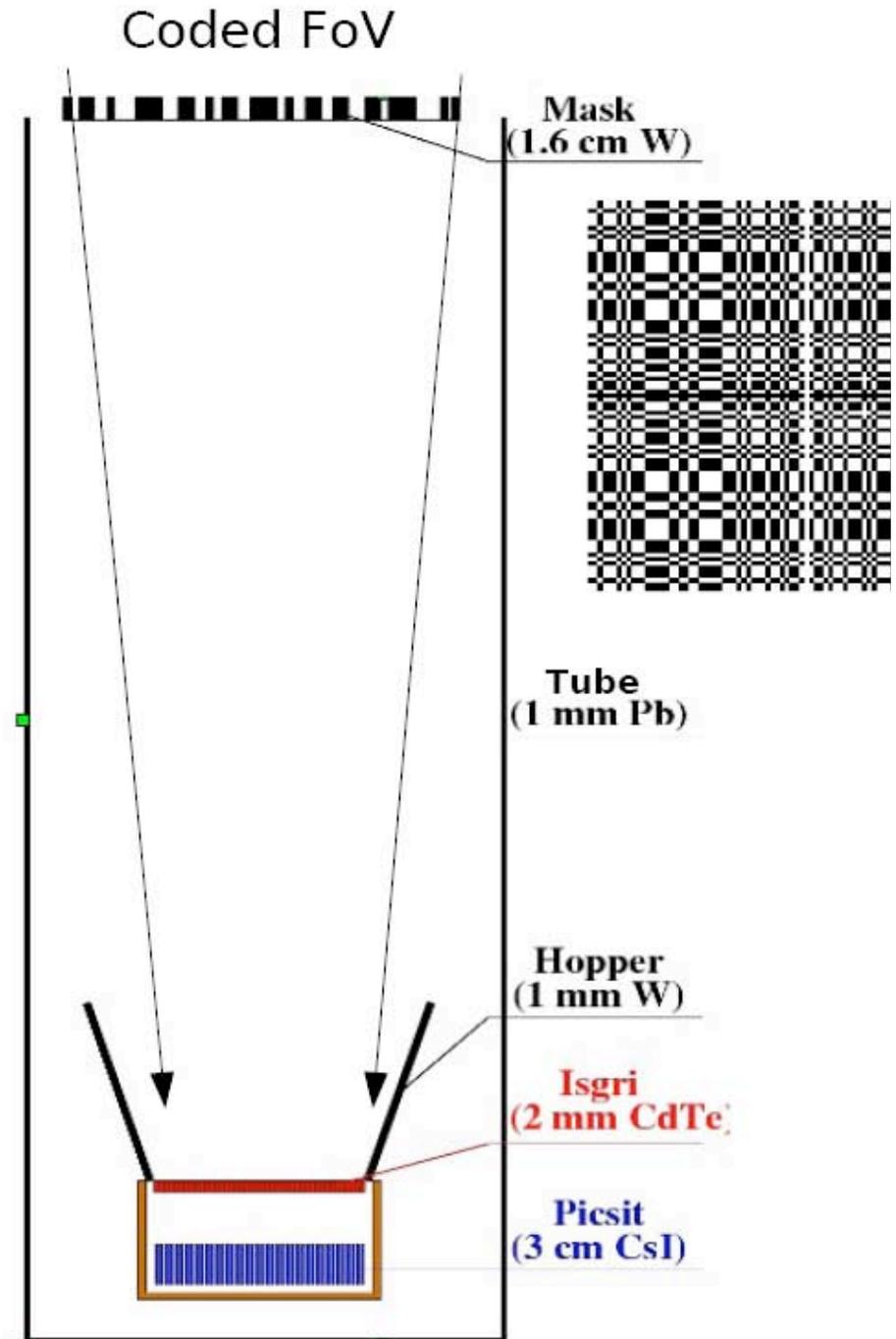
Satellite INTEGRAL



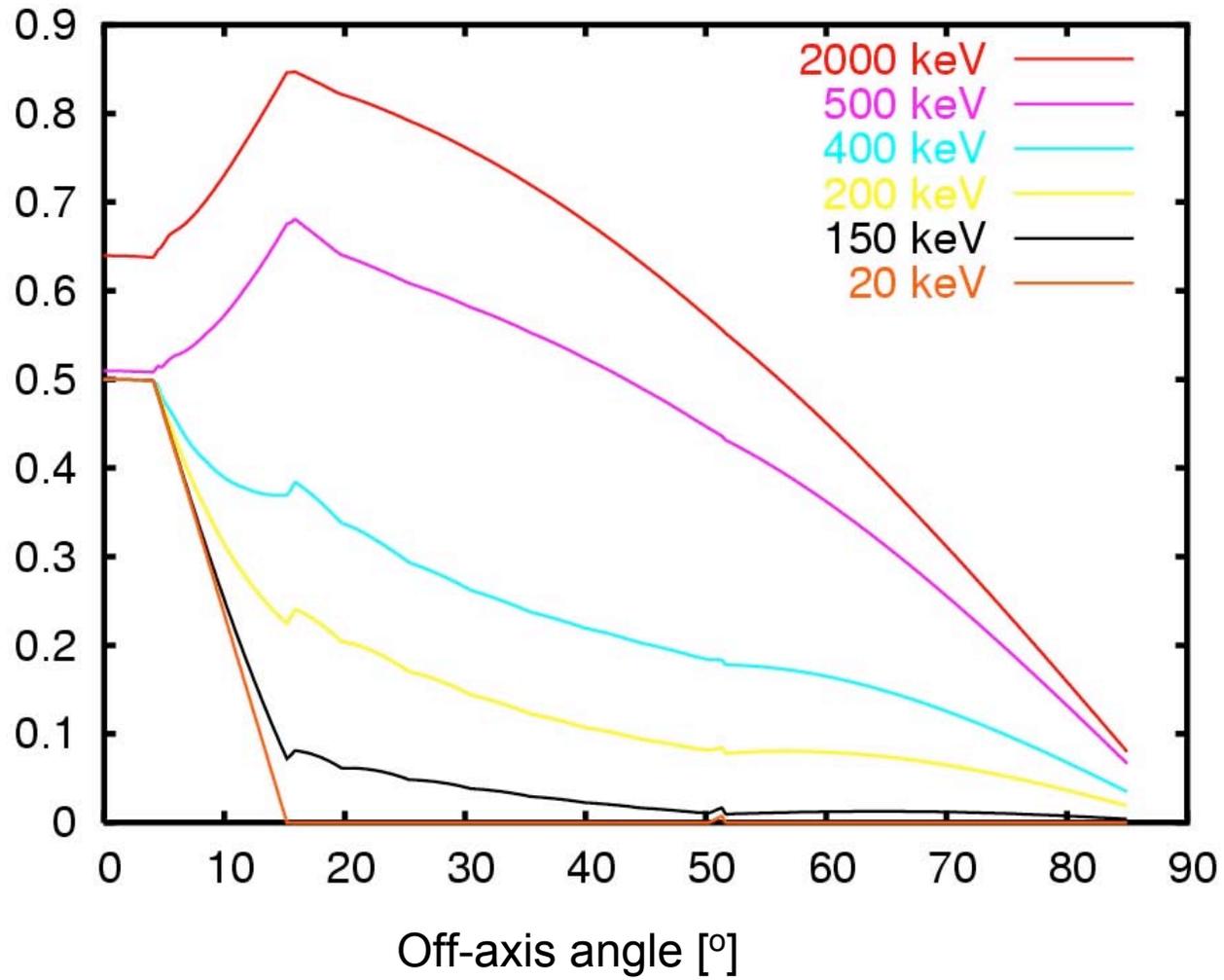
Telescope IBIS

IBIS Coded FoV - 30°

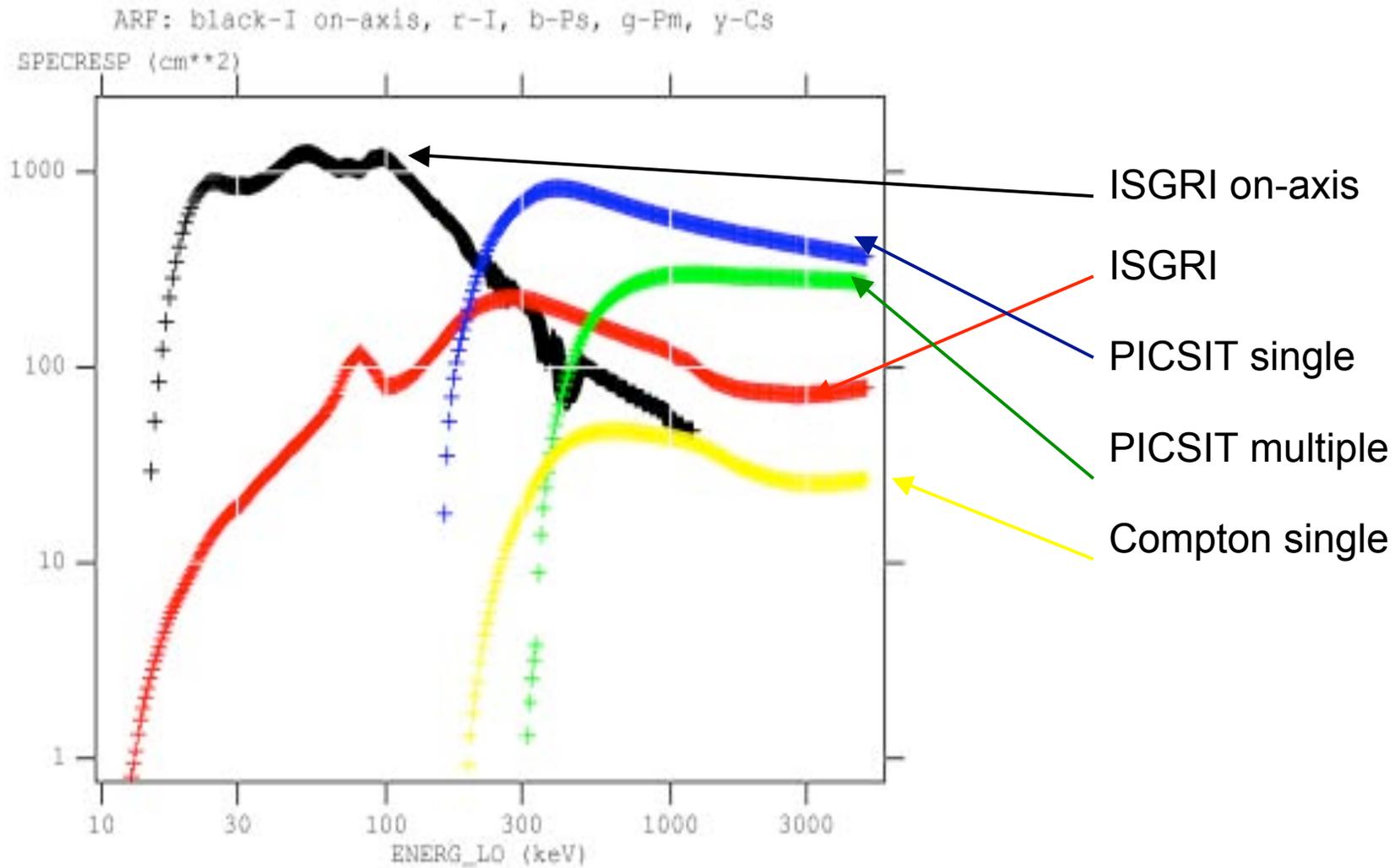
Compton scattering between
ISGRI and PICSIT – half of the sky
Compton instrument



IBIS tube transparency



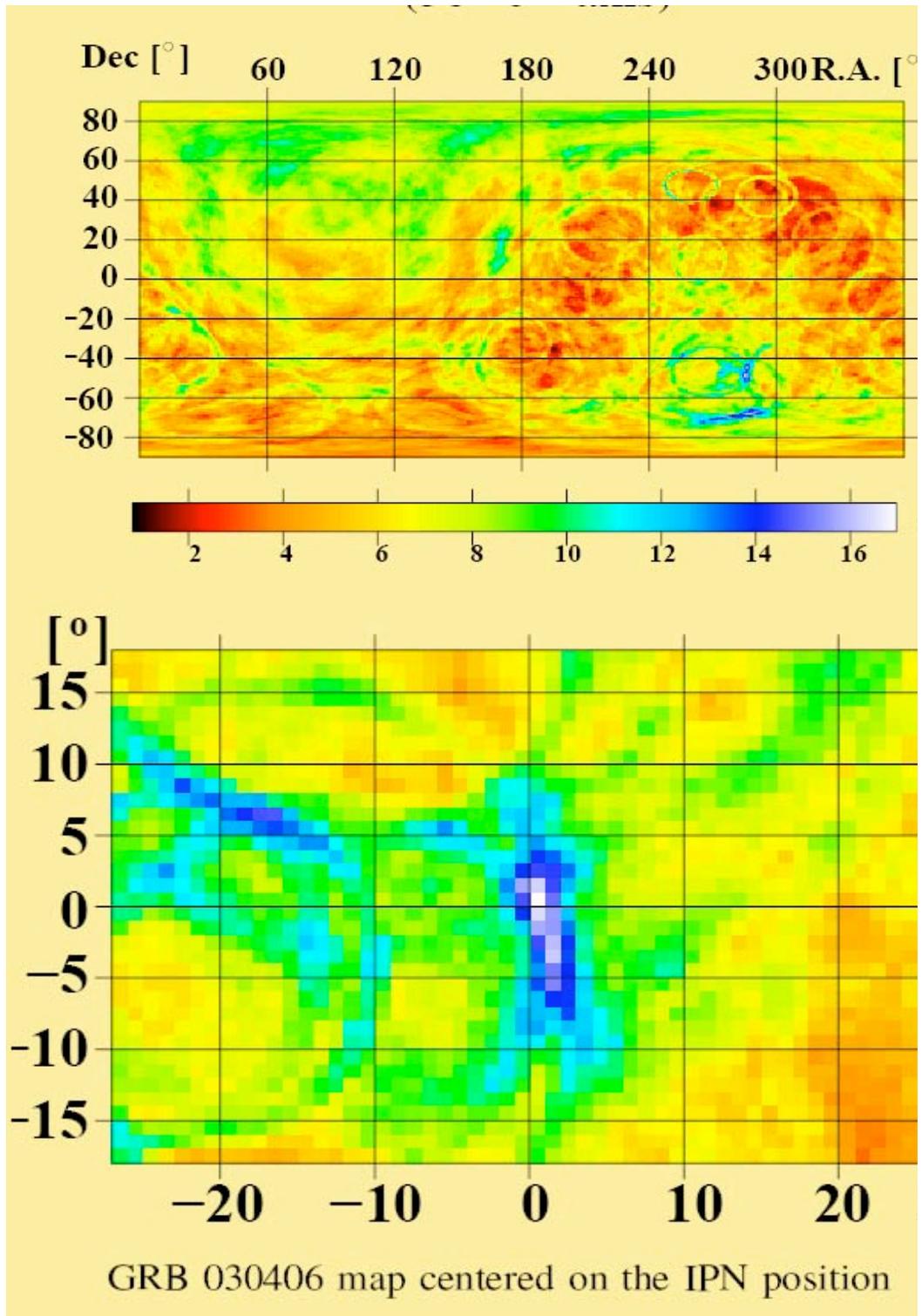
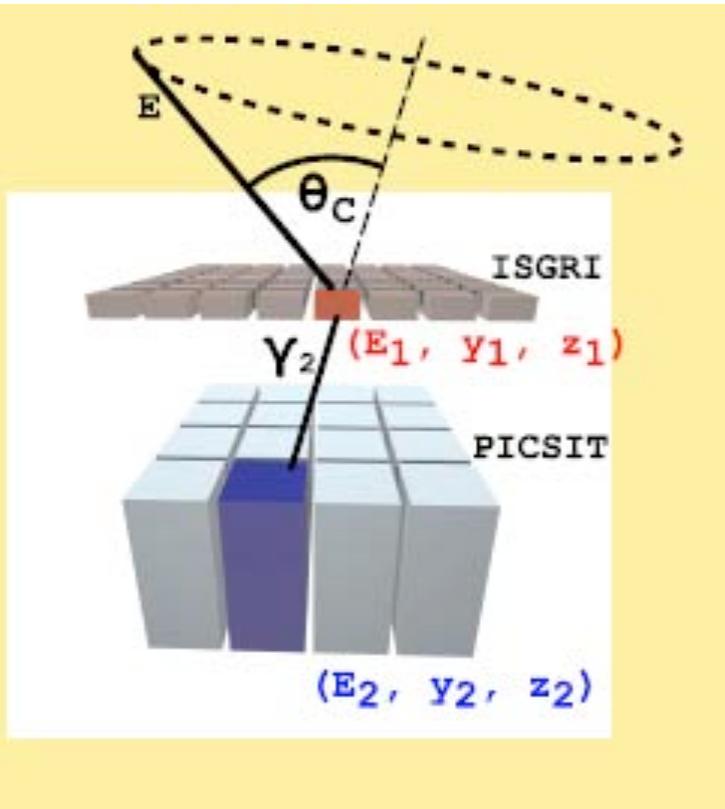
IBIS response – effective area



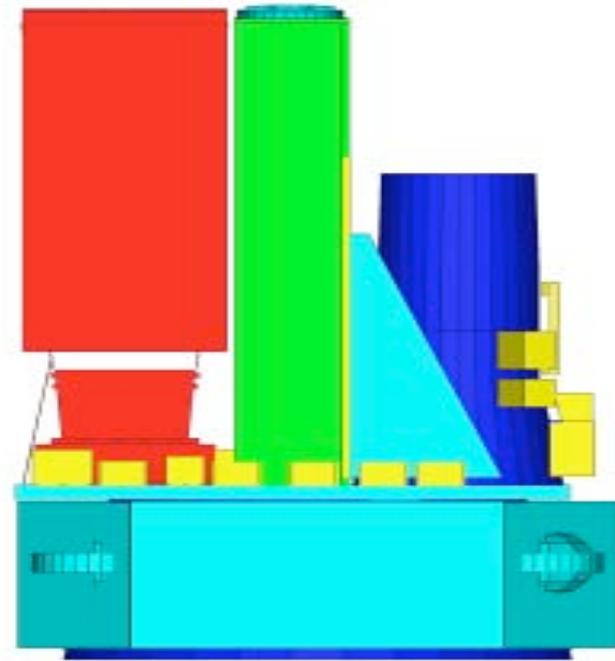
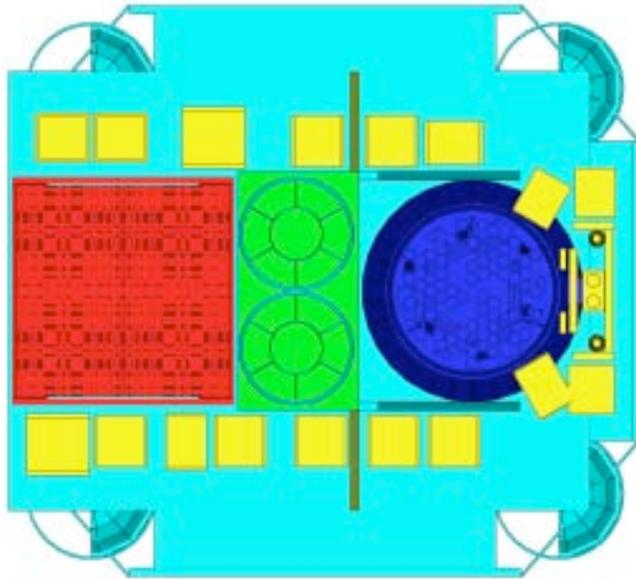
Localization

Accuracy of a few degrees

GRB 030406:



Integral Mass Model

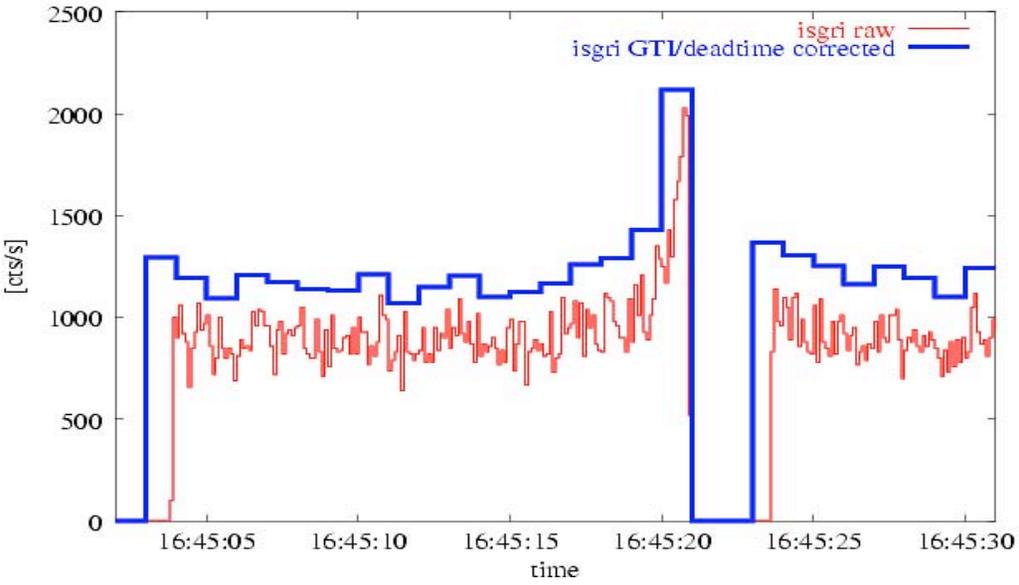


CERN geant3 simulation tool

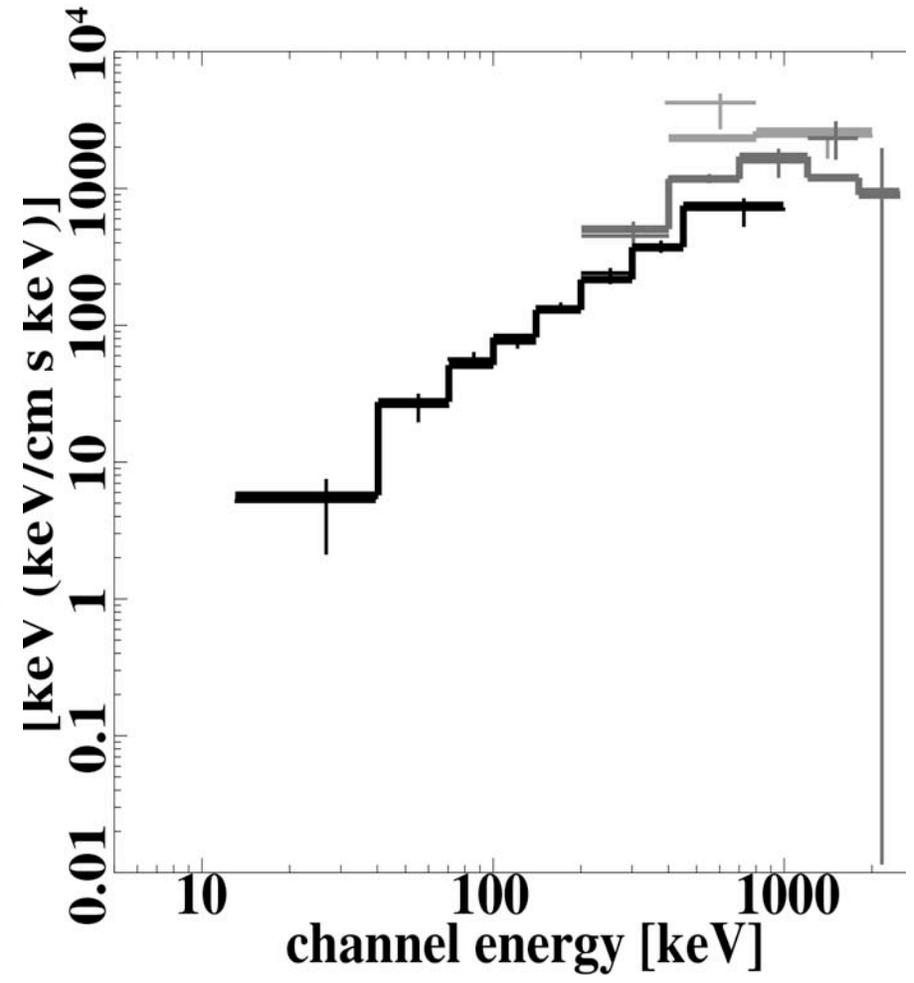
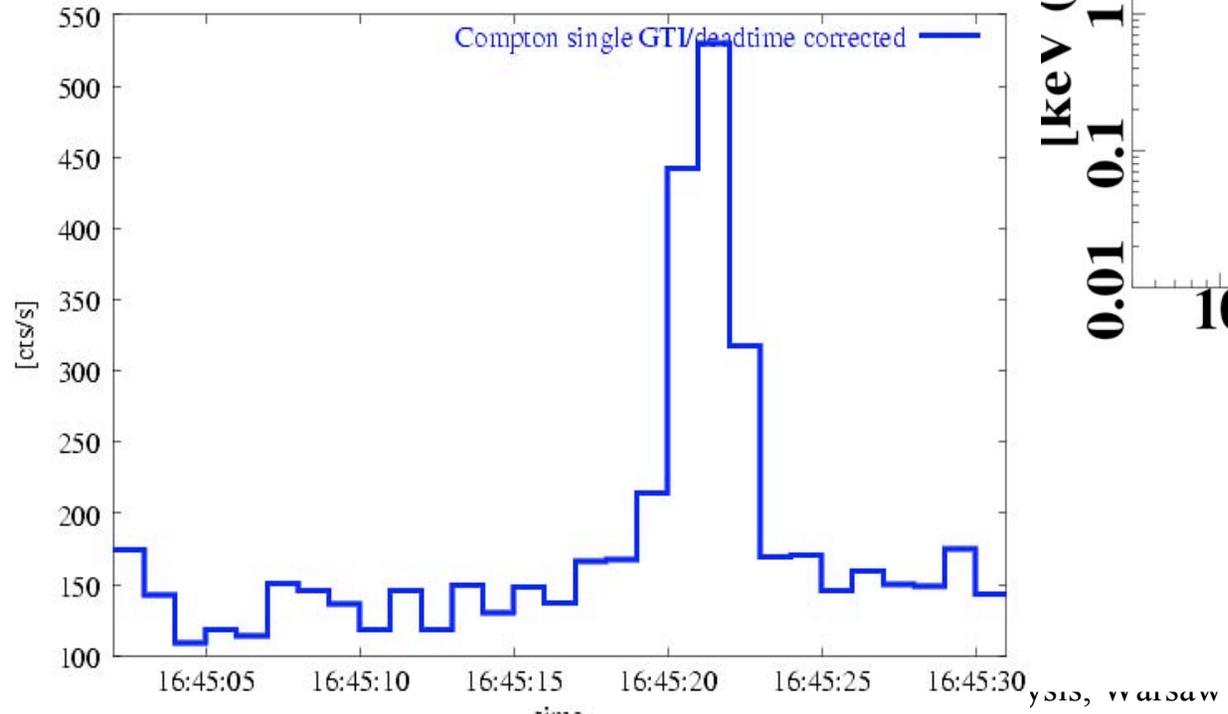
Need to find an individual response matrix for each bursts

GRB 031111 – lightcurve and spectrum

031111_0



031111_0

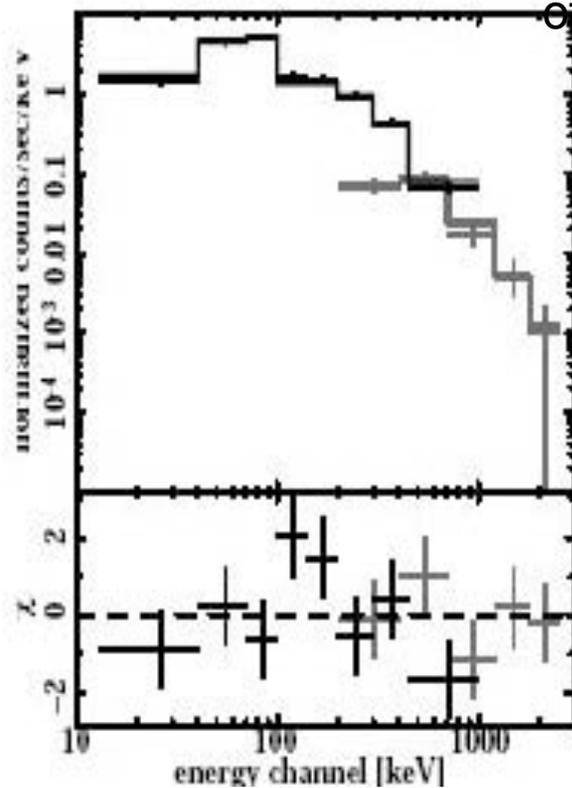
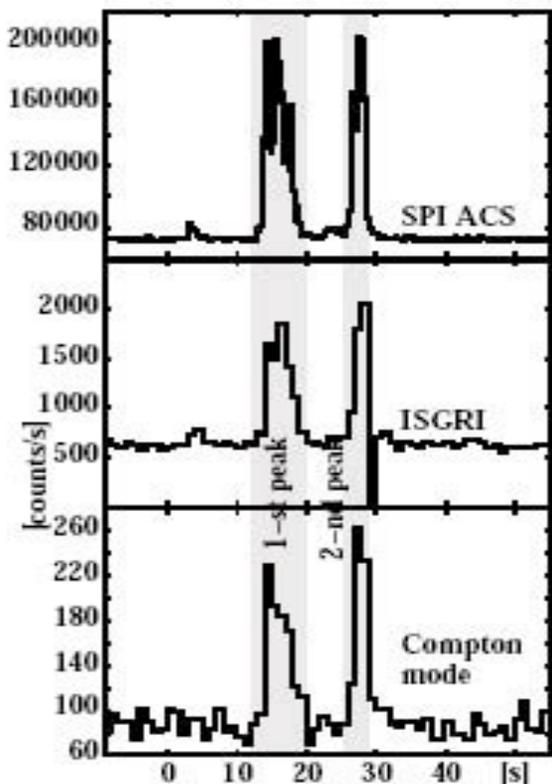


$i_1 = 0.6 \pm 0.2$
 $i_2 = 2.8 \pm 0.7$
 $E_{\text{break}} = 770 \text{ keV}$

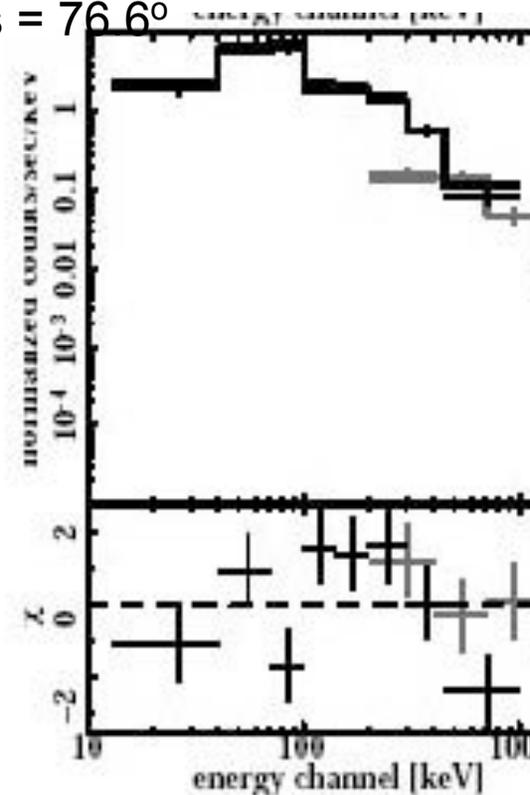
53 deg off axis

GRB 030722 – spectrum

Position: IPN triangulation -
annulus
and Compton imaging
duration = 15 s
off-axis = 76.6°

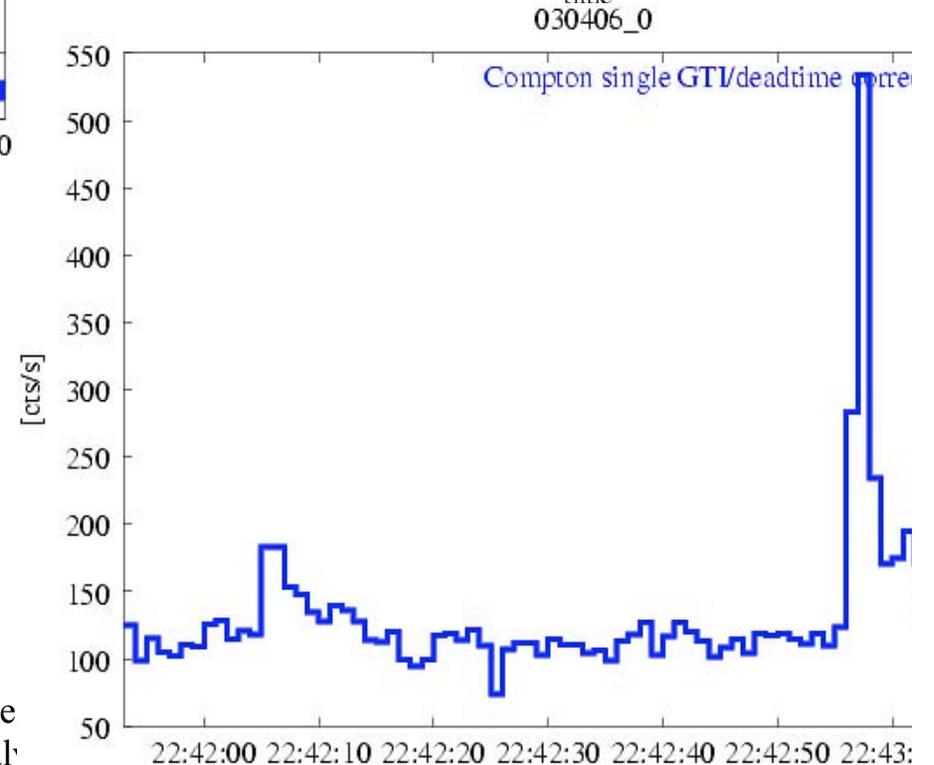
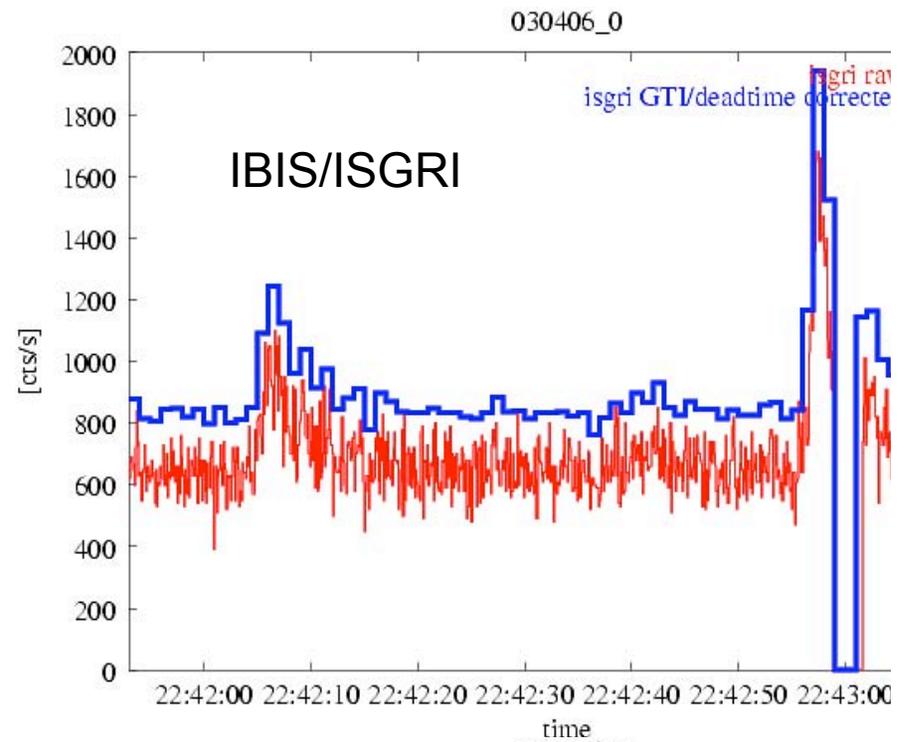
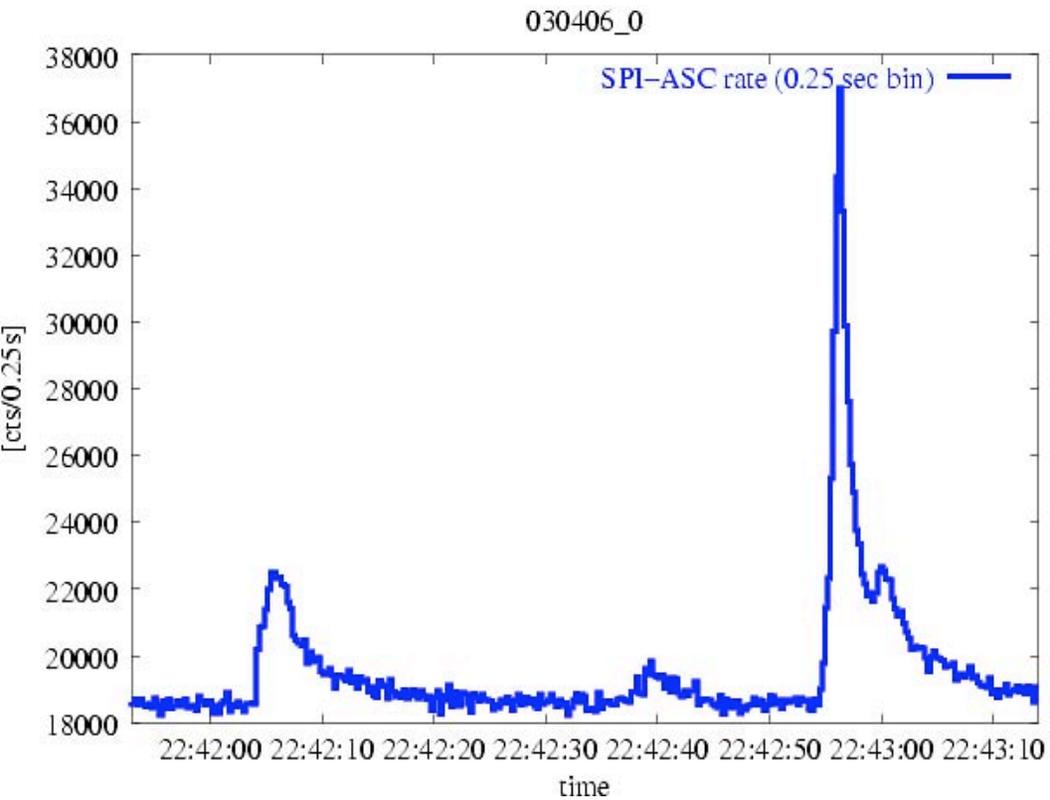


$l=2.07 \pm 0.05$
 $\chi^2/\text{dof}=1.23$



$l=2.05 \pm 0.06$
 $\chi^2/\text{dof}=1.9$

GRB 030406 – light curve



Position: IPN triangulation
and Compton imaging
duration = 70 s
off-axis = 36.9°

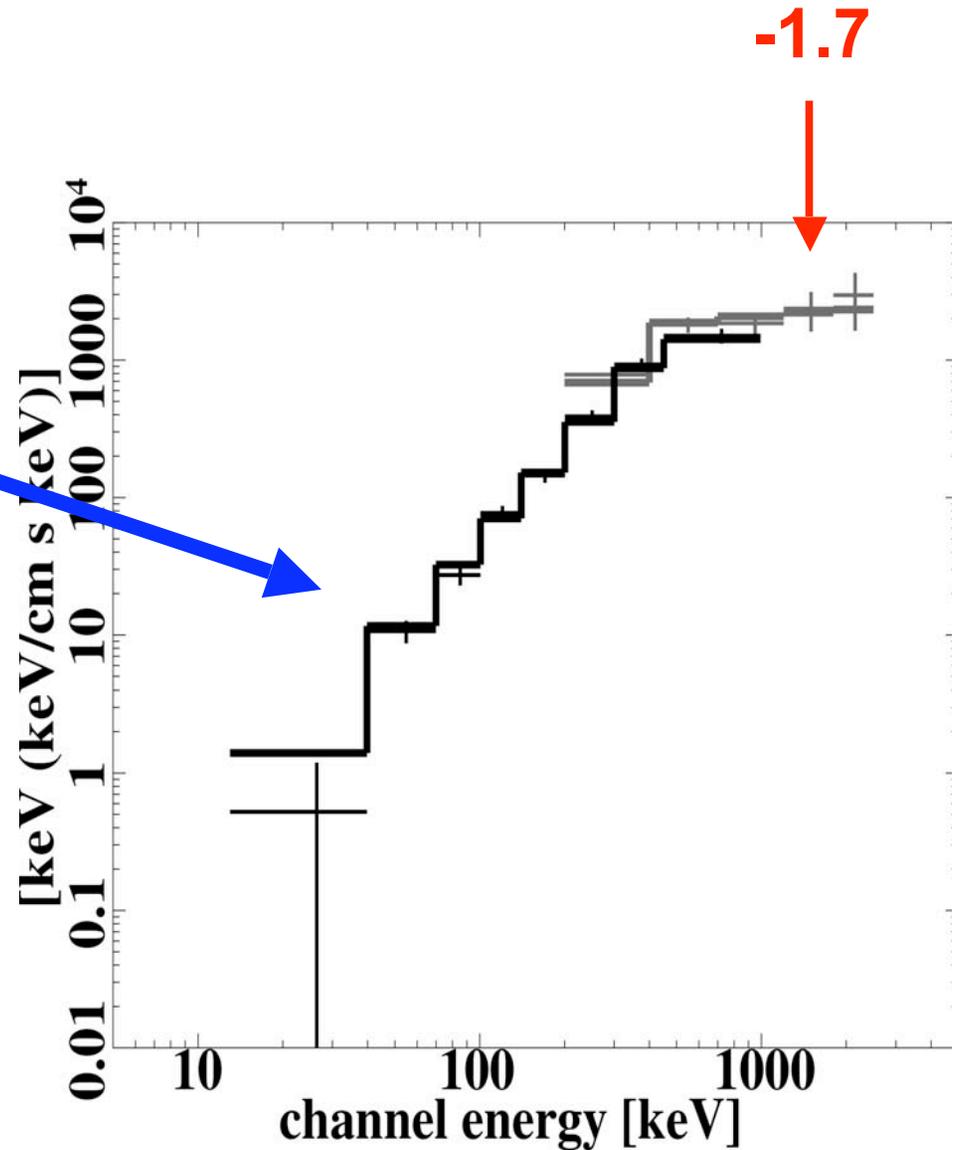
IBIS/Compton

M.Denis, IBIS/Inte
spectral anal:

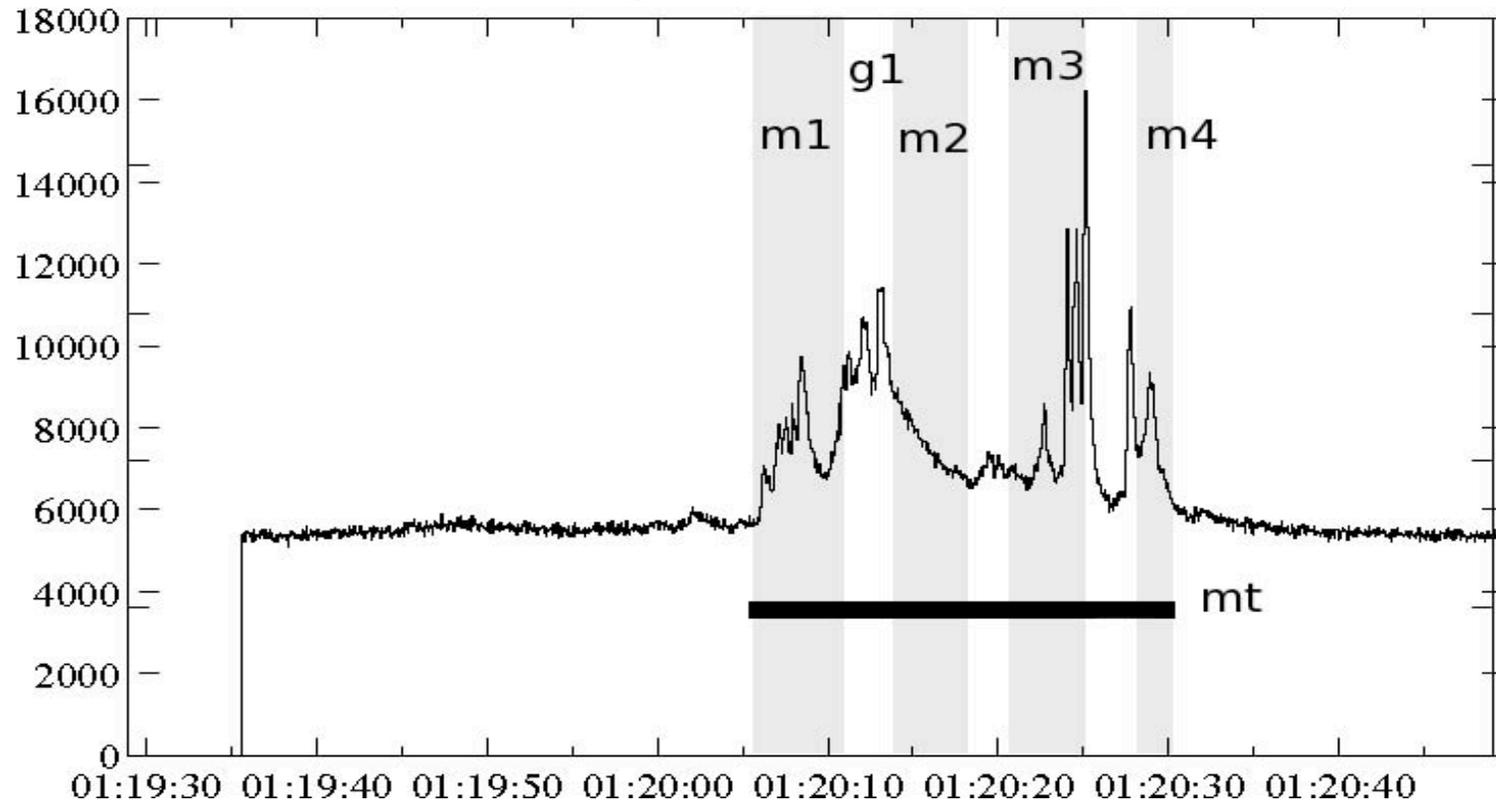
GRB 030406 spectrum

νF_ν spectrum during the main peak:

spectral index -1.5



GRB060928 lightcurve and spectrum



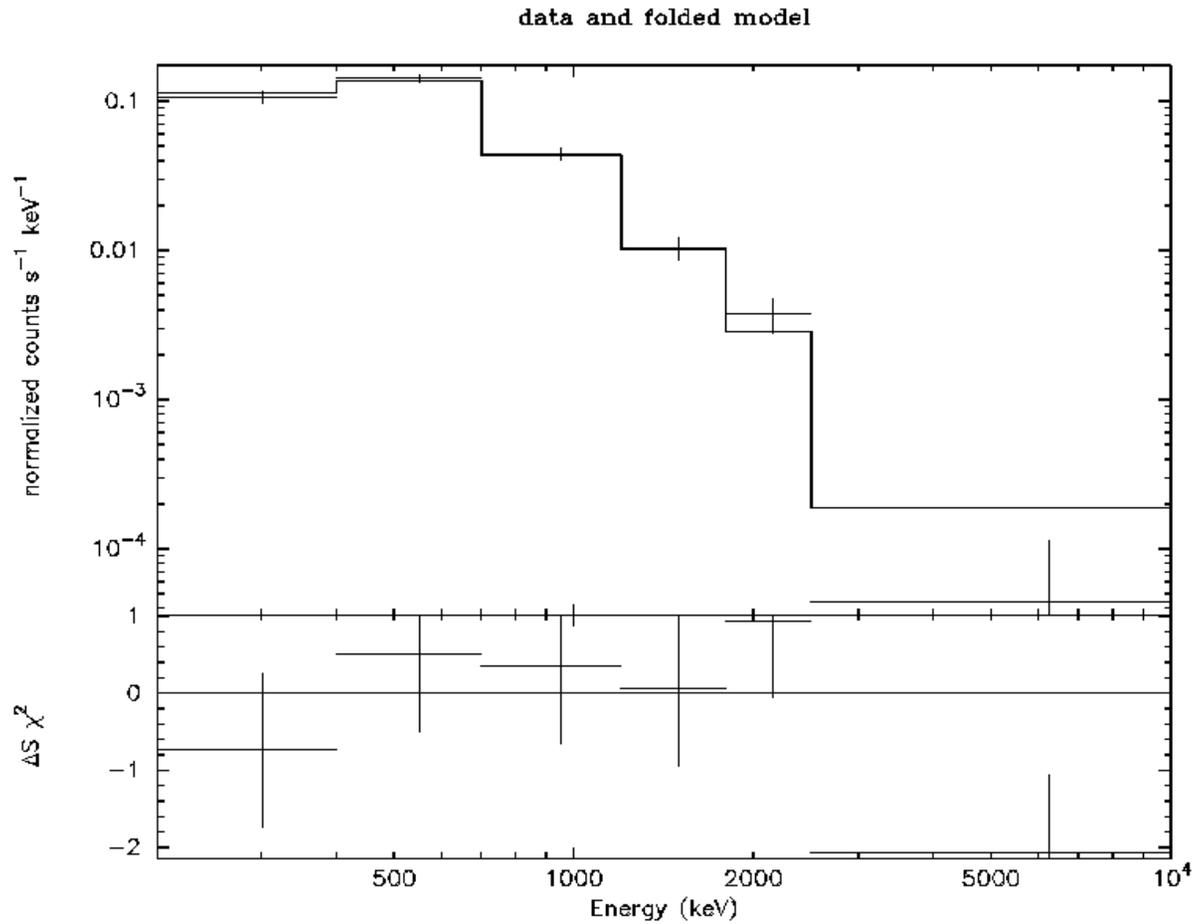
High energy photon index (ISGRI +Compton fit):

m1: -1.76 ± 0.15

m2: -2.08 ± 0.21

m3: -2.35 ± 0.21

m4: -2.18 ± 0.27



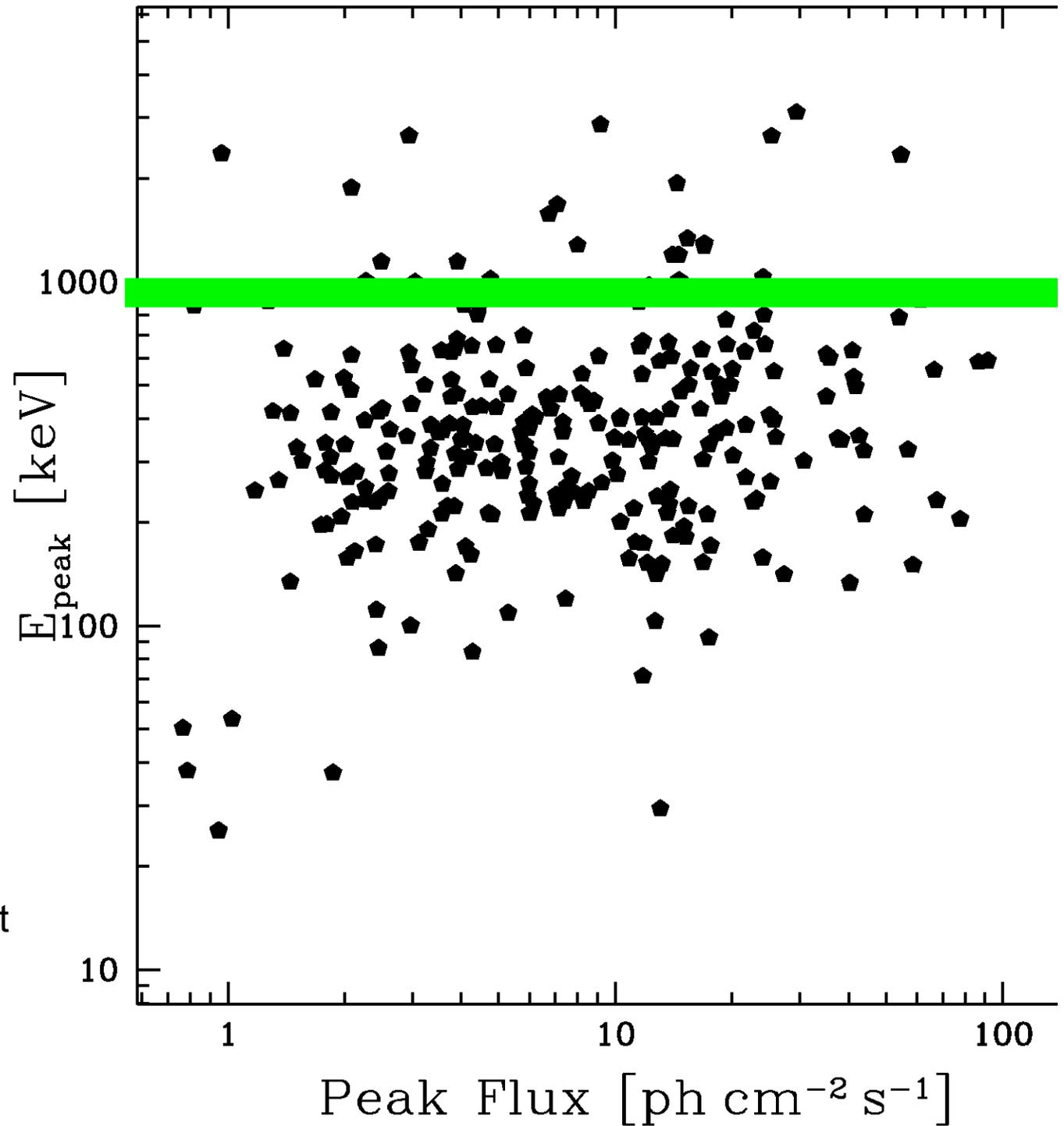
30-Nov-2006 10:34

Compton spectrum for the total duration of the burst:

spectral index: -1.95 ± 0.1 stretching to 5MeV

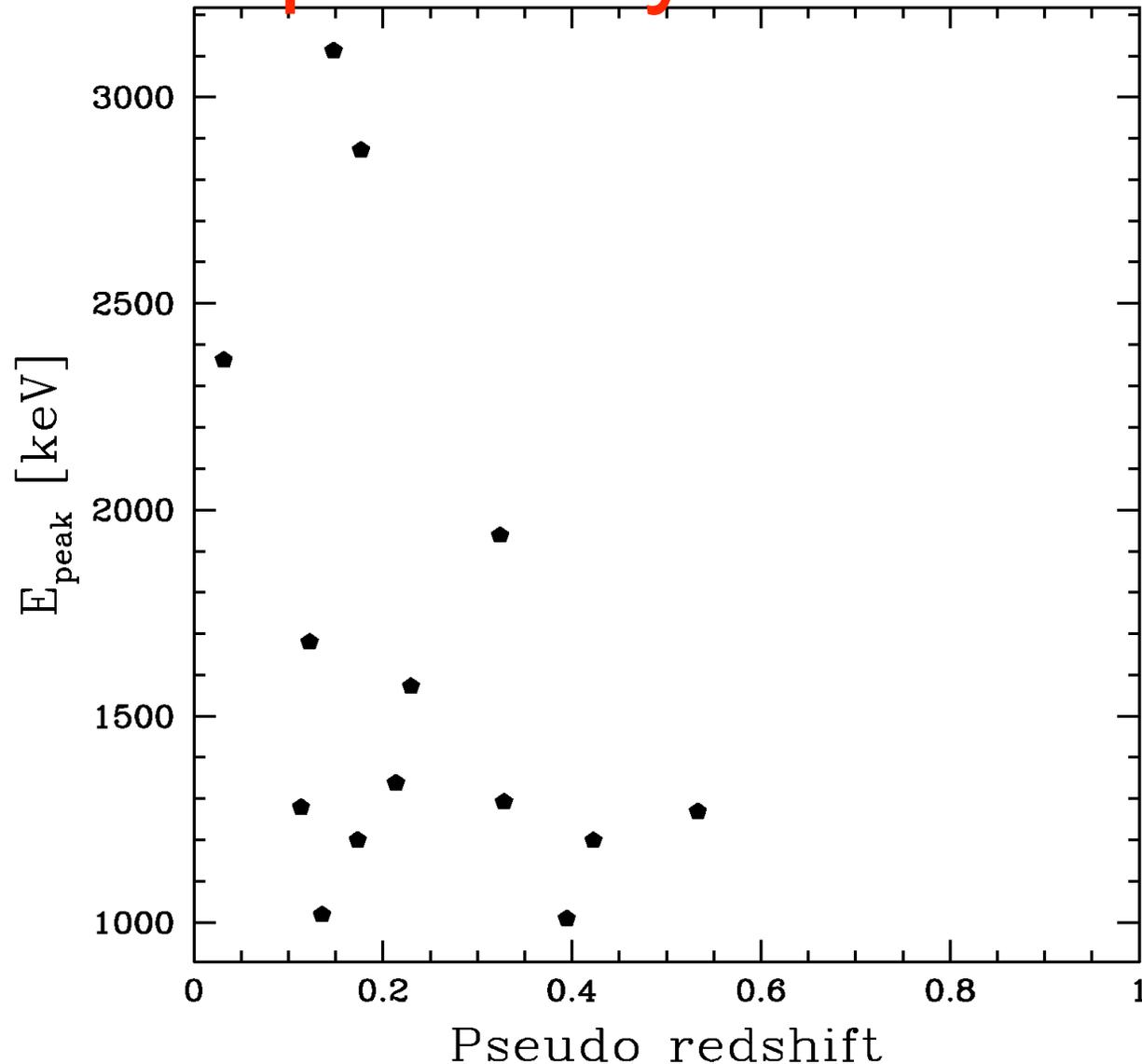
What do we know
from BATSE?

E peak at one second
around the maximum
photon flux



BATSE complete
spectra catalog of bright
GRBs,
Kaneko et al 2006.

Are they at very high redshift ? -
probably not



Pseudo redshift: A. Pelangeon, J.L. Atteia, and L.Osuch

Summary

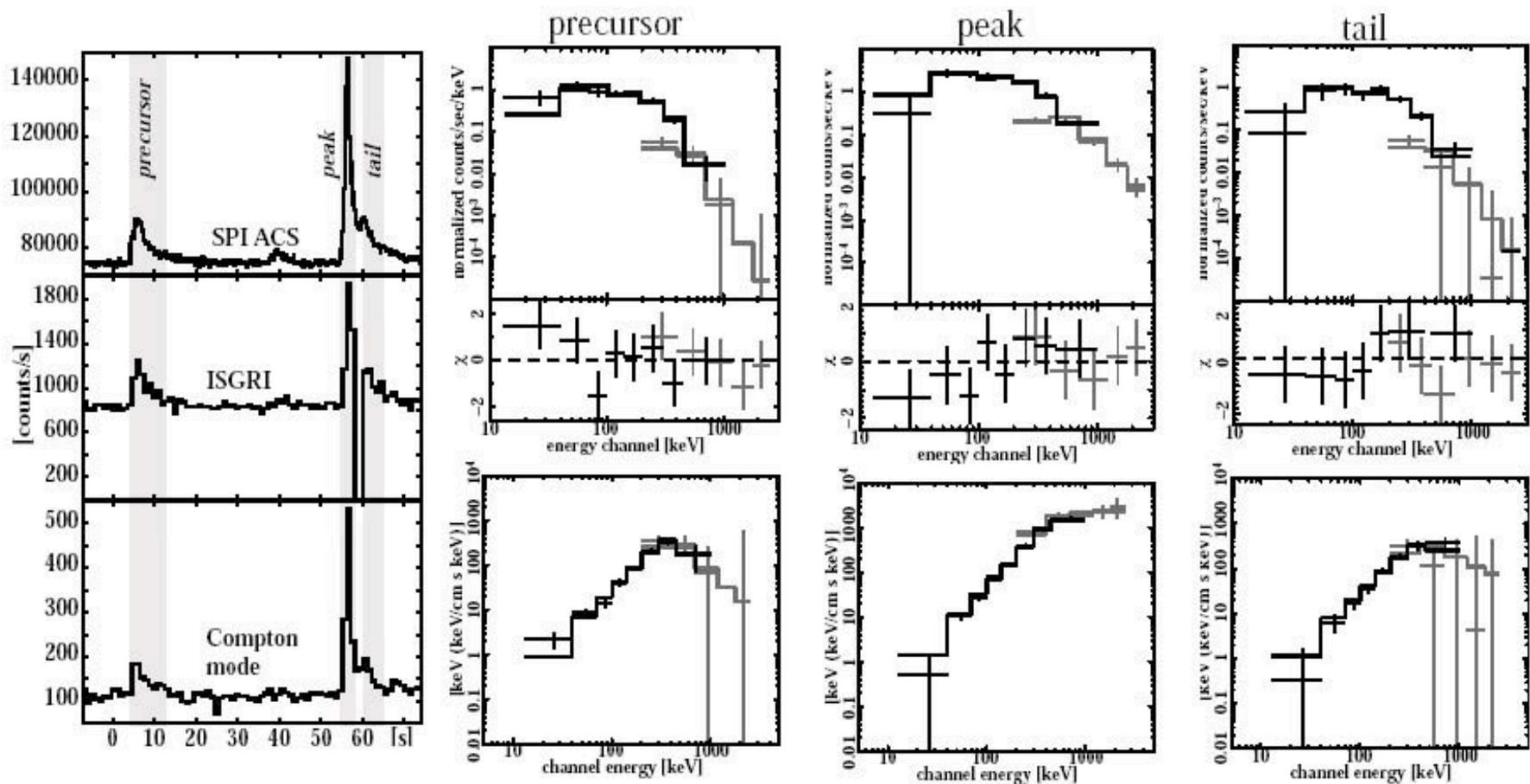
- We see bursts with E -peak stretching into the MeV range
- The rate is a few per year

Questions:

- How high does the spectrum stretch?
- Are there Very Hard GRBs ?

<http://grb.cbk.waw.pl>

GRB 030406 – spectrum



part	[s]	α	β	E_{break}
precursor	7.3	$0.0^{+0.3}_{-0.3}$	9.0^{+1}_{-6}	490^{+40}_{-180}
peak	2.81	$-1.5^{+0.7}_{-1.0}$	$1.7^{+0.4}_{-0.3}$	390^{+60}_{-50}
tail	4.3	$-0.8^{+0.7}_{-2.2}$	$2.8^{+1.2}_{-0.6}$	270^{+70}_{-50}